RESEARCH ARTICLE

Influence of Different Planting Dates on Growth of Blackberry Cutting Under the Agro-Climatic Condition

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Abstract

Blackberry (*Rubus fruticosus* L.) is an economically important small fruit crop valued for its nutritional, and medicinal attributes. Its successful propagation through stem cuttings is highly dependent on environmental conditions especially the time of planting. This study evaluated the effect of planting dates (15th July, 25th July, 4th August, and 14th August) on the growth of blackberry plant cuttings under the agro-climatic environmental condition of Swat, Pakistan. The experimental study were conducted in 2016 by using a Randomized Complete Block Design (RCBD) with three replications. The data on sprouting percentage, survival percentage, number of leaves, shoot length, number of roots, and root length were collected, and statistically analyzed. The results revealed that planting dates on some parameters significantly affected such as number of leaves ($P = 0.0145$), root number ($P = 0.0302$), and shoot length ($P = 0.0477$), while sprouting percentage, survival percentage, and root length were non-significant. Meanwhile, cuttings planted on 15th July consistently exhibited the greater performance, by achieving the highest sprouting percentage (73.33%) followed by survival percentage (66.67%), number of leaves (9.33), shoot length (27.17cm), number of roots (13.33), and root length (14.00cm). However, later planting dates relatively weaker growth responses. We conclude from the study that mid-July provides the favorable environmental conditions (for example; temperature, humidity, and soil moisture) for growth and development of blackberry cuttings in Swat. Therefore, 15th July is recommended as the most suitable planting date for enhancing propagation and successive plant vigor under the local agro-climatic condition. Furthermore, multi-location and multi-season studies are suggested to support region wide recommendations.

Keywords: Blackberry; Planting Date; Plant Morphology; Plant Growth; Agro-Climatic Condition

Introduction

Blackberry (*Rubus fruticosus* L.) is a perennial fruit crop belonging to the family Rosaceae (Hall, 1990; Meng et al., 2022). It is an economically significant small fruit species, extensively cultivated in temperate and subtropical regions worldwide (Gao et al., 2023; Paudel et al., 2025). Determining its exact center of origin is challenging, as different *Rubus* species are distributed across Asia, Europe, North America, and South America, making blackberry one of the fruit crops with the broadest geographical distribution (Hall, 1990; Meng et al., 2022). Historically, blackberries have been valued as wild fruits, with many species harvested both for household consumption, and for commercial purposes (Hall, 1990). Beyond their appealing flavor, blackberries are highly regarded for their exceptional nutritional and medicinal properties. They are rich sources of vitamins, phenolic compounds, and antioxidants that contribute to various health benefits, and disease prevention (Kaume et al., 2012; Milivojević et al., 2010). Due to their growing consumer demand, nutritional importance, and adaptability to diverse environmental conditions, blackberry cultivation is expanding steadily across the globe, including Pakistan. However, the successful propagation, and establishment of blackberry plants are strongly influenced by several environmental and management factors, among which the timing of planting plays a pivotal roles (Cao et al., 2018).

However, propagation through stem cuttings is one of the most reliable and cost-effective methods for blackberry production, as it ensures genetic uniformity and preserves desirable cultivar characteristics (Clark & Finn, 2014; Reed et al., 2017). The success of this propagation technique is largely influenced by environmental factors such as temperature, humidity, and soil moisture, all of which vary with planting time (Hartmann et al., 2011). The selection of appropriate planting date is therefore critical, as it provides favorable conditions for root initiation, shoot emergence, and subsequent plant development (Alam et al., 2016). In contrast, planting at an unsuitable time may expose cuttings to suboptimal climatic conditions, leading to poor rooting, low survival rates, and reduced plant vigor (Ahmad et al., 2015). The blackberry cultivars are generally classified into two main growth habits trailing and erect each occurring in both thorny and thorn-less forms. Trailing cultivars such as Marion, Logan, Baba berry, and Young berry typically lack cold hardiness, and may experience severe damage at temperatures between 0 and 5 °F (−17.8 to −15 °C). In contrast, erect cultivars including Chester, Darrow, and Illini exhibit greater cold tolerance and can with stand temperatures as low as −15 to −20 °F (−26.1 to −28.9 °C) with minimal injury (Barney & Himelrick, 1999).

Moreover, blackberry is regarded as a highly suitable crop for small-scale growers owing to its relatively low establishment cost, simple orchard management practices, and high nutritional value (Antunes et al., 2000). A global survey conducted in 2005 reported that blackberries were cultivated on approximately 20,035 hectares worldwide, representing a 45% increase since 1995 (Strik et al., 2007). Currently, *Rubus* spp. ranks among the most important berry crops globally, with more than 20,000 hectares under cultivation, primarily across Europe and North America (Wang & Lin, 2000; Kafkas et al., 2008; Milivojević et al., 2011). Mexico has emerged as the leading global producer, harvesting approximately 56,800 tons of fruit in 2011, primarily for export markets (FAOSTAT, 2013). Nutritionally, blackberries are an excellent source of dietary fiber, essential minerals, proteins, and vitamins, while being naturally low in calories, fat, and sodium (Jeyaraj et al., 2022). They also exhibit strong antioxidant activity due to their high phenolic and anthocyanin content, which enhances their value as a functional food crop (García-Mendoza et al., 2023). For optimal growth and productivity, blackberries require well-drained sandy loam soils with a pH of 6.2 - 6.8, and adequate organic matter to support root development and nutrient uptake. The propagation of blackberries can be achieved through several conventional methods, including layering, offsets, and root or stem cuttings (Botez et al., 1984).

In addition, tissue culture techniques have been successfully developed to facilitate the rapid multiplication of uniform, disease free planting material within a relatively short period (Jenks, 2011). The Swat valley in northern Pakistan possesses favorable agro-climatic conditions for the cultivation of small fruit crops. However, it's pronounced seasonal variations in temperature and rainfall can substantially influence plant establishment, rooting, and overall growth performance. Identifying the optimal planting date is therefore essential for enhancing the survival and vigor of blackberry cuttings under these local environmental conditions. The previous research studies has demonstrated that even slight variations in planting time can significantly affect the growth dynamics, rooting success, and productivity of various fruit crops (Ali et al., 2017; Mehmood et al., 2019).

Furthermore, the research on the influence of planting dates on blackberry propagation exists globally, but no localized studies have been conducted under the specific agro-climatic conditions of Swat, Pakistan. This lack of region-specific information limits the development of optimal planting schedules for improving the growth performance of blackberry cuttings in the area. The present study hypothesized that planting date significantly affects the growth and propagation of blackberry cuttings under the agro-climatic conditions of Swat, with mid-July providing the most suitable conditions for optimal growth of the plant. The study pursue to answer the following research questions; *Q1. How do different planting dates influence the sprouting and survival percentages of blackberry cuttings? Q2. To what extent does planting date affect critical growth parameters, including number of leaves, number of roots, shoot length, and root length?* However, the primary aim of the current research study was to determine the most suitable planting date for the successful growth and propagation of blackberry cuttings under the agro-climatic conditions of Swat. Moreover, the main objectives of the study were (1) to evaluate the effect of different planting dates on the sprouting and survival percentages of blackberry cuttings, (2) to assess the influence of suitable planting date on key growth parameters such as number of leaves, number of roots, shoot length and root length, and (3) to identify the optimal planting date that ensures the maximum growth, and propagation success rate under the agro-climatic conditions of Swat. Further, the findings of the study are planned to provide practical evidence base recommendations to local growers, young researchers, and horticulture practitioners to promote blackberry cultivation and propagation in the region.

Methodology

A research study entitled "Influence of different planting dates on the growth of blackberry cuttings under the agro-climatic condition" was conducted in 2016 at the Agriculture Research Institute, Mingora, and Swat, Pakistan. The softwood cuttings of blackberry were selected for propagation.

Experimental Materials and Design

The dormant pencil-sized cuttings, approximately 20cm in length, were prepared from healthy blackberry plants and planted in a growth medium under shade-house conditions. High humidity was maintained to minimize water loss through transpiration. A total of 120 cuttings were used, with ten cuttings per treatment, planted on four different propagation dates (D1: 15 July, D2: 25 July, D3: 4 August, and D4: 14 August). The experiment was arranged in a Randomized Complete Block Design (RCBD) with a single factor (propagation date) and three replications. Within each block ten cuttings were assigned to each propagation date, so a total to 30 cuttings per block and 120 cuttings overall.

Data Collection

Blackberry is an important medicinal and economic fruit plants of KP-Pakistan especially of district Swat. The survey was carried out during the year of 2016. The data were collected on various parameters of the berry such as sprouting period, survival period, number of leaves per plant, number of roots per plant, shoot length (cm), and root length (cm).

Parameters studied and method of recording data

During the experiment data was collected on the following parameters.

Sprouting percentage

Sprouting percentage was calculated by observing emergence in five randomly selected plants per replication and then the average was calculated by equation 1.

$$\text{Sprouting percentage (\%)} = \frac{\text{Number of cuttings sprouted}}{\text{Total number of cuttings planted}} \times 100 \qquad \text{Equation…1}$$

Survival percentage

After complete sprouting and successful growth of these cuttings at the end of growing season for each treatment in each replication plant survival percentage was calculated by equation 2.

$$\text{Survival percentage (\%)} = \frac{\text{Number of plants survived}}{\text{Total number of plants Planted}} \times 100 \qquad \text{Equation…2}$$

Number of roots per plant: Roots were counted in all plants, and average were calculated for each treatment and replication

Root length (cm): The length of roots from five randomly selected plants per replication was measured and averaged.

Shoot length (cm): The length of newly sprouted shoots from five randomly selected plants per replication was recorded using a measuring tape and averaged.

Number of leaves per plant: Leaves were counted on five randomly selected plants per replication, and the mean was calculated.

Statistical Analysis

All recorded data were subjected to analysis of variance (ANOVA) using the RCBD model. Mean separation was performed using the Least Significant Difference (LSD) test at the 5% probability level, where differences were statistically significant. Statistical analyses were performed by using STATISTIX software version 8.1 (Jan et al., 2022).

Results and Discussion

The results of the study entitled “Influence of different planting dates on growth of blackberry cutting under the agro-climatic condition” are presented and discussed below.

Sprouting percentage

The results revealed that planting dates had a non-significant effect on sprouting percentage. The mean value comparison highlight that the maximum sprouting (73.33%) was observed in cuttings planted on 15th July, followed by (70.00%) cuttings planted on 4th August. The lowest sprouting (50.00%) was recorded in cuttings planted on 25th July. However, the differences were statistically non-significant (*P = 0.4449*) (Table. 1 & 2; Figure. 1). The research findings are supported by Irshad et al. (2014), who studied the effect of planting dates and media on the growth of kiwi plant cuttings, and Ahmad et al. (2012), who observed the effect of different budding time of peach plant.

Table 1. Sprouting percentage and mean value of plant replication under different planting dates.

Planting Dates	R1	R2	R3	Mean
15th July	70%	80%	60%	73.333
25th July	30%	70%	50%	50.000
04th Aug	70%	70%	80%	70.000
14th Aug	90%	70%	40%	66.667

Table 2. Analysis of variance for sprouting percentage of replication under various planting dates.

Source	DF	SS	MS	F	P
R	2	450.00	225.000		
PD	3	966.67	322.222	1.03	0.4449
Error	6	1883.33	313.889		
Total	11	3300.00	CV	27.26	

Note: Abbreviations; DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

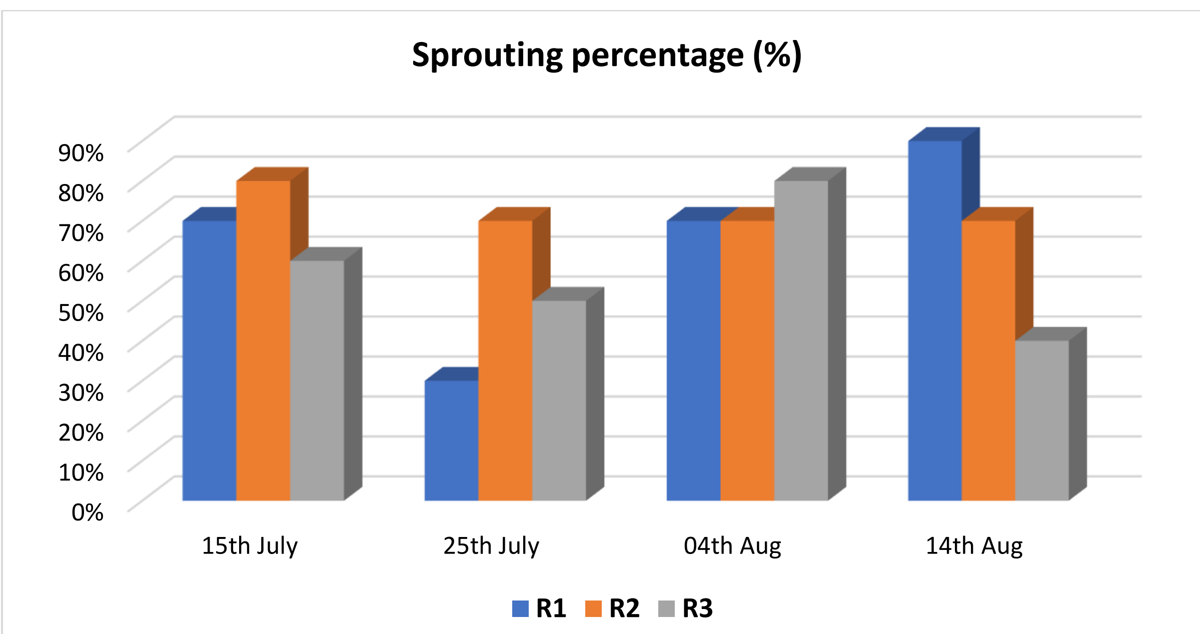

Figure. 1 Comparison of sprouting percentage among various planting dates and replications.

Survival Percentage

The planting dates did not significantly influence survival percentage. The mean values highlight that the highest survival percentage (66.67%) was observed in cuttings planted on 15th July, followed by (63.33%) in cuttings planted on 4th August. The lowest percentage (46.67%) was recorded in cuttings planted on 25th July. Although, differences were evident, they were statistically non-significant (*P = 0.4547*) (Table. 3 & 4; Figure. 2). The study findings are supported by Irshad et al. (2014), who observed the effect of planting dates on the growth of kiwi plant cuttings.

Table. 3 Survival percentage and mean value of plant replication under different planting dates.

PLANTIND DATES	R1	R2	R3	Mean
15th July	60%	60%	80%	66.667
25th July	30%	60%	50%	46.667
04th Aug	70%	70%	50%	63.333
14th Aug	70%	70%	40%	60.000

Table. 4 Analysis of variance for survival percentage under various planting dates.

Source	DF	SS	MS	F	P
R	2	216.67	108.333		
PD	3	691.67	230.556	1.00	0.4547
Error	6	1383.33	230.556		
Total	11	2291.67	CV	25.66	

Note: Abbreviations: DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

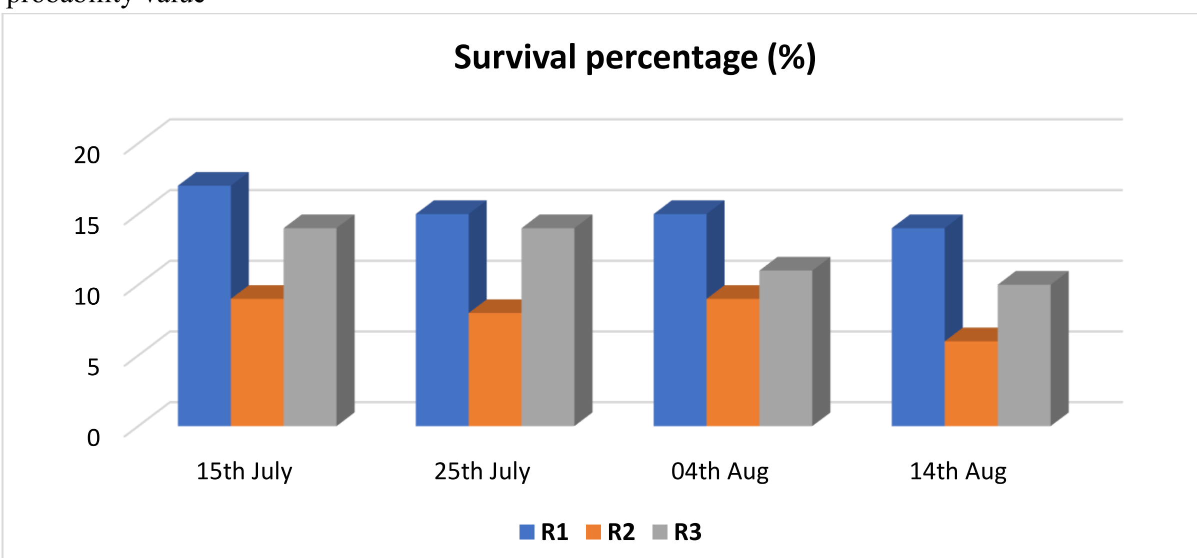

Figure 2. Comparison of survival percentage among various planting dates and replications

Number of Leaves per Plant

The planting dates significantly influenced the number of leaves per plant. The highest mean value of leaf number (9.33) was recorded in cuttings planted on 15th July, followed by 6.33 in cuttings planted on 4th August. The lowest value (0.00) was recorded in cuttings planted on 14th August. The higher leaf production in mid-July plantings may be due to early sprouting, which resulted in greater shoot elongation and consequently higher leaf numbers ($P = 0.0145$) (Table. 5 & 6; Figure. 3). However, similar results were reported by Yong and Kisum (1996), who observed maximum leaf numbers in plants with enhanced underground and aerial growth.

Table 5. Number of leaves and mean value of plant replication under different planting dates

PLANTIND DATES	R1	R2	R3	Mean
15th July	9	13	6	9.333a
25th July	6	6	4	5.333a
04th Aug	7	4	8	6.333a
14th Aug	0	0	0	0.000ab
LSD	-	-	-	1.9003

Table 6. Analysis of variance for number of leaves under various planting dates.

Source	DF	SS	MS	F	P
Row	2	3.500	1.7500		
Planting	3	136.250	45.4167	8.38	0.0145
Error	6	32.500	5.4167		
Total	11	172.250	CV	44.3	

Note: Abbreviations: DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

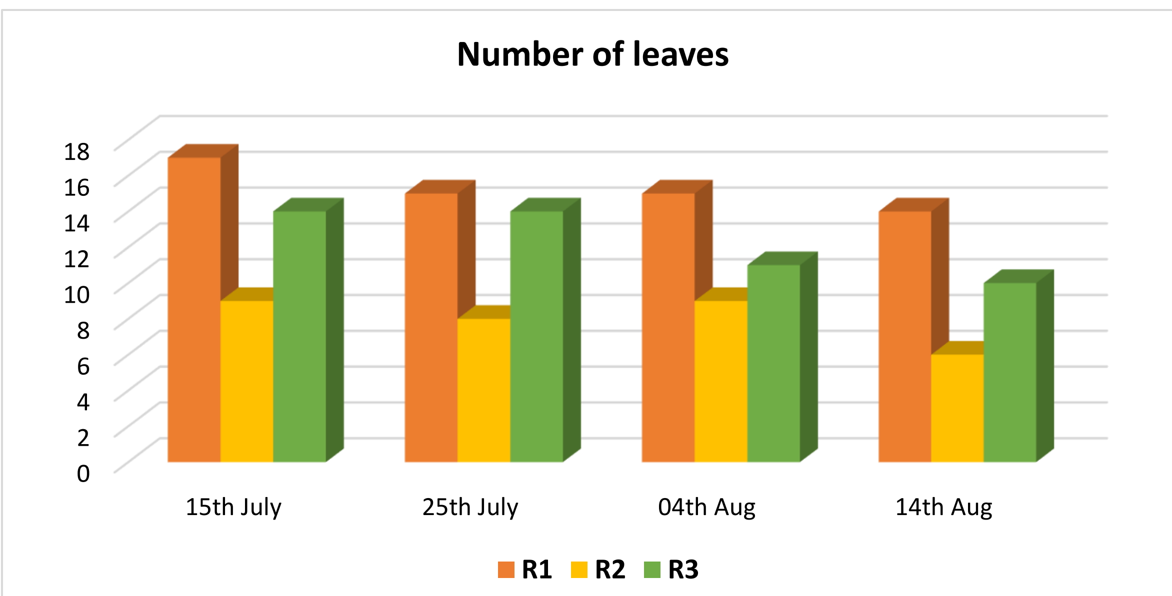

Figure. 3 Comparison of the number of leaves among replication across different planting dates

Number of Roots per Plant

The planting dates significantly affected number of roots per plant. The maximum number of roots (13.33) was recorded in cuttings planted on 15th July, followed by 12.33 in cuttings planted on 25th July. The lowest root number (10.00) was observed in cuttings planted on 14th August. The greater root number in July plantings may be attributed to early sprouting, which provided more time for root development (*P = 0.0302*) (Table. 7 & 8; Figure. 4). However, similar findings were reported by Sajid et al. (2012), who observed higher root numbers in *Platanus orientalis* with early sprouting and enhanced vegetative growth.

Table 7. Number of roots and mean value of plant replication under different planting dates.

PLANTIND DATES	R1	R2	R3	Mean
15^{th} July	17	9	14	13.333a
25^{th} July	15	8	14	12.333 a
04^{th} Aug	15	9	11	11.667ab
14^{th} Aug	14	6	10	10.000b
LSD	-	-	-	0.80501

Table 8. Analysis of variance for number of roots under various planting dates.

Source	DF	SS	MS	F	P
Row	2	106.167	53.0833		
Planting	3	17.667	5.8889	6.06	0.0302
Error	6	5.833	0.9722		
Total	11	129.667	CV	8.33	

Note: Abbreviations: DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

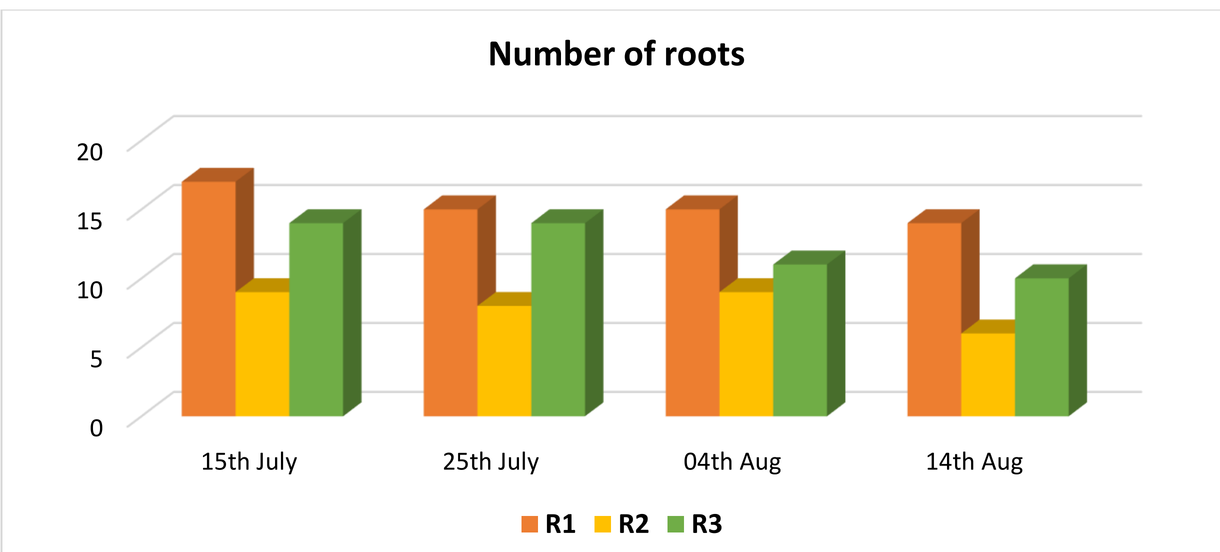

Figure. 4 Comparison of the number of roots among replication across different planting dates.

Shoot Length (cm)

The maximum shoot length (27.17 cm) was observed in cuttings planted on 15th July, followed by 18.07cm in cuttings planted on 4th August. The lowest shoot length (0.00cm) was recorded in cuttings planted on 14th August. The enhanced shoot elongation in mid-July plantings can be attributed to early sprouting and longer vegetative growth duration. Planting dates significantly influenced shoot length with (P = 0.*0477*) (Table. 9 & 10). Though, similar results were reported by Khan et al. (2016), who studied maximum aerial growth in plants established earlier in the season.

Table 9. Shoot length (cm) and mean value of plant replication under different planting dates.

PLANTIND DATES	R1	R2	R3	Mean
15th July	16.7cm	34.8cm	30cm	27.167a
25th July	8cm	15cm	5.7cm	9.5667ab
04th Aug	23.2cm	4cm	27cm	18.067ab
14th Aug	0.00cm	0.00cm	0.00cm	0.000 b
LSD	-	-	-	7.4464

Table 10. Analysis of variance for shoot length (cm) under various planting dates.

Source	DF	SS	MS	F	P
Row	2	27.76	13.878		
Planting	3	1215.58	405.193	4.87	0.0477
Error	6	499.04	83.174		
Total	11	1742.38	CV	66.57	

Note: Abbreviations: DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

Root Length (cm)

The statistical analysis revealed that planting dates had a non-significant effect on root length. The maximum root length (14.00cm) was recorded in cuttings planted on 15th July, followed by 12.50cm in cuttings planted on 25th July. The lowest root length (3.91cm) was recorded in cuttings planted on 14th August. Despite these variations, the results were statistically non-significant (P = 0.*0477*) (Table. 11 & 12). However, similar findings were reported by Khan et al. (2016), who studied the effect of timing and bud numbers on growth of dwarf umbrella tree cuttings.

Table 11. Root length (cm) and mean value of plant replication under different planting dates

PLANTIND DATES	R1	R2	R3	Mean
15th July	28.5cm	4.5cm	9cm	14.0
15th July	24cm	11cm	2.5cm	12.5
04th Aug	8.5cm	3cm	6.5cm	6.0
14th Aug	2.93	6.1cm	2.7cm	3.9
LSD	-	-	-	NS

Table. 12 Analysis of variance for root length (cm) under various planting dates

Source	DF	SS	MS	F	P
R	2	285.908	142.954		
PD	3	216.348	72.116	1.46	0.3170
Error	6	296.813	49.469		
Total	11	799.069	CV	77.27	

Note: Abbreviations: DF = Degree of freedom, SS = Sum of square, MS = Mean Square, F = Ratio of variance, P = probability value

Conclusion

In the light of findings of the present study, the following conclusion were drawn. We conclude that planting date plays a critical role in the successful growth and propagation of blackberry cuttings under the agro-climatic conditions of Swat. Although, cutting planted on 15th July highlight the highest overall numerical performance, the improvement was not uniform across all the traits. The statistical analysis revealed that number of leaves ($P = 0.0145$), number of roots ($P = 0.0302$), and shoot length ($P = 0.0477$) were significantly affected by planting date. While, parameters such as sprouting percentage ($P = 0.4449$), survival percentage ($P = 0.4547$), and root length ($P = 0.3170$) were non-significantly affected. The mid-July climatic conditions, characterized by moderate temperatures and adequate humidity provided an optimal environment for root initiation and shoot development, whereas delayed planting particularly after early August, resulted in poor growth and establishment. Therefore, it can be concluded that 15th July is the most suitable planting date for blackberry cuttings in Swat. These findings provide valuable guidance for farmers and horticulturists aiming to improve blackberry cultivation and highlight the importance of timely planting in maximizing propagation success. We recommend that further studies on the impact of multi-location and multi-season are needed to support the current research work under the agro-climatic conditions.

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Data availability Statement: Data sharing is not applicable to this article, as the available data mentioned in main tables.

Author's contribution: Misbah Uddin[1] and Farman Ullah[2] conceived the main idea; Sammiya Jabeen[5], Farman Ullah[3], Muhammad Amjad[6] and Asad Ullah[3] designed the methodology; Misbah Uddin[1], Muhammad Usama[3], and Farman Ullah[3] helps in data collection; Tariq Jamal[5], and Sammiya Jabeen[5] design references; Misbah Uddin[1], Farman Ullah[2], Waqar Ahmad[3] and Sunbal Jehan[4] helps in scientific writing, critical review and final approval of the draft.

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